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IS 4496 (1968): Screen luminance for the projection of 16 mm film by incandescent lamps [MED 32: Photographic Equipment]

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Indian Standard

**SCREEN LUMINANCE FOR THE PROJECTION
OF 16 mm FILM BY INCANDESCENT LAMPS**

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SCREEN LUMINANCE FOR THE PROJECTION OF 16 mm FILM BY INCANDESCENT LAMPS

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SCREEN LUMINANCE FOR THE PROJECTION OF 16 mm FILM BY INCANDESCENT LAMPS

0. F O R E W O R D

0.1 This Indian Standard was adopted by the Indian Standards Institution on 16 January 1968, after the draft finalized by the Cinematographic Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Work on the formulation of standards for various cinematographic equipment has been undertaken with a view to establishing acceptable levels of quality and performance as well as bringing about a degree of interchangeability in these units. This is one of the series of Indian Standards on cinematographic equipment.

0.3 In contrast with 35 mm projectors, which are customarily permanently installed in a separate projection room and use high power arc illuminants, 16 mm projectors are usually small and portable with an incandescent lamp.

0.4 In an architect-designed cinema, consideration is given to the shape and height of the auditorium, the control of stray light from doors and windows, properly designed 'Exit' signs and auditorium lighting, specially chosen colours for walls, ceilings, and decorations, and the location of the projectors in a separate projection room. All of these factors are so designed and co-ordinated as to achieve the required luminance of the screen from the projector with the minimum of stray light falling on the screen.

On the other hand 16 mm films are most frequently projected where the conditions are by no means so good. The facilities for darkening the hall or room cannot, in general, compare with the superior conditions of the cinema auditorium, and an appreciable quantity of stray light may enter from windows and doors, and either reach the screen direct or be reflected on to it from walls and ceiling. Some light may be spilled from the projector, which is usually located in the auditorium itself. Of the light reflected from the screen some will be re-reflected on to the screen from walls and ceiling, and the amount of this re-reflected light will be relatively much higher than in a cinema, for the occasional auditorium the ceiling will usually be much lower, and the colour of walls and ceiling much lighter.

0.5 Stray light falling on the screen inevitably degrades the contrast of black-and-white pictures and both the colour and contrast of colour pictures, and it is, therefore, important to keep stray light to a minimum.

0.6 Notwithstanding the fact that the light output of 16 mm projectors is limited by the nature of the light source, there is a tendency among users of 16 mm equipment to demand a picture which is larger than that which the projector can give at this 'ideal' luminance on a matt white screen. However, by the use of beaded or metallized screens a much larger picture may be obtained with the 'ideal' luminance, but this level of luminance is available only to those of the audience who sit near the centre line of projection; towards the sides of the auditorium the level of luminance may be less than would be the case if a matt white screen were used.

0.7 On a matt white screen an over-large picture should necessarily result in a level of luminance below the 'ideal'. Fortunately, the human eye is very adaptable, and experiment has shown that projected pictures, both colour and black-and-white, are acceptable at levels of luminance less than the 'ideal'. In a well-darkened auditorium an acceptable picture is obtainable at levels down to a luminance of 21 cd/m^2 . Below this level the degradation of contrast and colour quality results in unsatisfactory presentation.

0.8 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard recommends the screen luminance (brightness) for the projection of 16 mm colour, and black-and-white cinematograph film by incandescent lamps.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Candela (Cd) — The unit of luminous intensity. Its magnitude is one-sixtieth of the luminous intensity of one square centimetre of a black-body radiator operated at the temperature of solidification of platinum.

2.2 Luminance (at a Point of a Surface in a Given Direction) (Brightness) — The quotient of the luminous intensity in the given

*Rules for rounding off numerical values (revised).

direction of an infinitesimal element of the surface containing the point under consideration, by the orthogonally projected area of the element of a plane perpendicular to the given direction.

2.3 Brightness — The attribute of the visual appearance with which an area seems to emit more or less light. This attribute is sometimes referred to as luminosity or 'apparent brightness' and are not expressed in ordinary photometric terms.

NOTE — A good way of explaining the essential difference between 'brightness' and 'luminance' is to quote the following sentence:

'An automobile headlight seems to have much higher *brightness* at night than in the day time, but its *luminance* remains unchanged'.

2.4 Side — It is a position on the horizontal axis of the projected picture 5 percent of its width inwards from the edge.

3. SCREEN LUMINANCE (BRIGHTNESS)

3.1 It is recommended that the luminance of the screen, measured from any seat in the auditorium by the method and under the conditions specified in Appendix A, should be as follows:

- a) The luminance of the centre should be not less than 27 nor more than 55 cd/m^2 .

NOTE 1 — In certain circumstances it may be desired to project a picture which is larger than that which the projector is capable of giving with the lower limit of luminance recommended above. Experiment has shown that a luminance of 21 cd/m^2 can provide an acceptable picture.

NOTE 2 — In certain circumstances it may be desired to project at a luminance higher than the upper limit recommended above. Experiment has shown that some 16 mm film may be shown satisfactorily, without noticeable grain or flicker, at levels of luminance up to 82 cd/m^2 .

- b) The luminance of each side measured on the horizontal axis should not be less than 0·6 times the measured luminance at the centre, and should preferably be as near as practicable to 0·7.

NOTE — Experiment has shown that the most artistic presentation of the picture results not when the screen is illuminated uniformly over its whole area, but when the luminance diminishes towards the sides and corners. It is for this reason that it is recommended that the luminance at the sides should be as near as practicable to 0·7 times the luminance at the centre.

4. STRAY LIGHT

4.1 It is recommended that the level of luminance of the screen due to stray light, from all sources, should not exceed 1 percent of the luminance of the centre of the screen, determined under the conditions given in Appendix A.

4.2 It is related to the total of stray light from whatever source. Such sources will include light entering the auditorium from doors and windows, all lighting within the auditorium including that spilled from the projector, whether reaching the screen directly or by reflection from walls and ceiling, and reflected light from the screen re-reflected from walls and ceiling.

4.3 A method of measurement of luminance due to stray light falling on the screen is given in Appendix B.

4.4 With directional (beaded or metallized) screens, the ratio of the luminance of the screen due to stray light to the luminance of the screen due to the projected light, will vary from seat to seat in the auditorium. To determine compliance with 4.1 when directional screens are used, it is necessary for measurements to be made of both projected light luminance and stray light luminance, from a number of seats in the auditorium. Every pair of measurements should give a ratio complying with 4.1.

4.5 Whilst with levels of stray light up to that quoted above the picture still remains acceptable, it should nevertheless be kept in mind that any stray light whatever tends to degrade the picture to some extent. To achieve black-and-white presentation of good contrast, and colour presentation of good contrast and colour quality, every endeavour should be made to reduce stray light to a minimum particularly at the lower levels of screen luminance. For high contrast black-and-white pictures, for example, cartoons or line drawings, a level of luminance due to stray light up to 2 percent may not be objectionable.

4.6 The colour of the stray light has an appreciable effect on the acceptability of the picture, particularly in the case of colour film. Stray light which tends to have a pronounced colour will degrade a picture appreciably more than an equivalent level of white light.

APPENDIX A

(Clauses 3.1 and 4.1)

CONDITIONS AND METHOD FOR MEASURING SCREEN LUMINANCE

A-1. CONDITIONS OF MEASUREMENT

A-1.1 The measurement of the luminance of the screen shall be made with the projector running under normal operating conditions, with no film in the gate, and with the auditorium darkened as for normal projection. The conditions shall remain constant throughout the complete series of measurements.

A-2. PHOTOMETER

A-2.1 The screen luminance shall be measured with a visual photometer in which the screen or a suitable part of it is viewed through a small telescope which has centrally in its field of view a small comparison spot, obscuring not more than 1° of this field. The comparison spot is illuminated to a sensibly uniform lance by a small electric lamp, the luminous intensity of which can be adjusted so as to be kept constant. The luminance of the comparison spot is to be capable of variation by suitable means, for example, neutral wedges, so as to be made to match that of the screen whose luminance is required. The device which alters the luminance of the comparison spot is calibrated so that the luminance of the spot, and hence that of the screen with which it is matched, can be determined.

The error in the indication of the instrument at any point within the effective range shall not exceed 20 percent of the indication.

A-3. NUMBER OF MEASUREMENTS

A-3.1 At least four measurements of the luminance of each selected portion of the screen should be made from each selected position in the auditorium. The mean value of these four measurements shall be regarded as the measured luminance of that portion of the screen as viewed from that position in the auditorium. If more than one observer takes measurements, then each observer should make the same number of observations, which should be not less than four for each observer.

APPENDIX B

(Clause 4.3)

METHOD OF MEASUREMENT OF LUMINANCE OF SCREEN DUE TO STRAY LIGHT

B-1. GENERAL DESCRIPTION OF THE METHOD

B-1.1 To measure the luminance of the screen due to the incidence, on the screen, of all the stray light that will be present under normal projection conditions, it is necessary to run the projector with the auditorium normally darkened and to project, on to the screen, a quantity of light approximately equal to that projected when an average scene is being shown, and this in practice is about 10 percent of the total light output of the projector. It is necessary to prevent the direct light from the projector lens from falling on a small part of the screen and to measure the luminance of that part. The magnitude of this luminance, expressed as a

percentage of the luminance of the centre of the screen under the conditions of Appendix A, will indicate whether the projection conditions comply with 4.1.

B-2. METHOD OF MEASUREMENT

B-2.1 Darken the auditorium as far normal projection.

B-2.2 Run the projector, using some means to reduce its light output to about 10 percent of the value obtained with no film in the gate. Some of the suitable means are:

- Run a film having, over all the picture area, a density of 2.0, and having spaced approximately uniformly in the top and bottom thirds of the picture area, a number of clear areas, the sum of these areas being such that the total light incident on the screen is the desired reduced light output.
- Insert in the projector gate, or immediately in front of the projection lens, a neutral density filter of such density as to give the desired reduced light output. If a filter is used in front of the lens it should be of a type that does not diffuse or scatter the light falling on it.
- Cover the projection lens with a cap having a central circular hole the diameter of which has been determined by trial to give the desired reduced light output.

B-2.3 Place a circular opaque baffle, matt black on both sides, of diameter approximately 10 percent of the picture width, between the projector and the centre of the screen at a distance from the latter equal to one picture width.

Note — With a baffle dimensioned and positioned as indicated in B-2.3 the penumbra will be sufficiently small, and the size of the shadow will be adequate (it will subtend an angle of approximately 1 degree at a distance of 5 screen widths). Furthermore, it will be possible to measure the luminance of the shadowed area from any position except within 3 degrees of the normal to the screen passing through the centre of the shadow. The difference between a measurement normal to the screen and the one 3 degrees off is likely to be small (less than 10 percent) even with a beaded screen.

B-2.4 Measure the luminance of the screen in the shadow of the baffle, which is the luminance of the screen due to stray light.

The photometer used for this measurement shall comply with the requirements of A-2.1 and shall be capable of measuring down to at least 0.2 cd/m^2 .

Note — In the case where a matt screen is in use and equipment for measuring luminance is not available, the stray light luminance ratio may be determined to a sufficiently close approximation by using an illumination meter. In this case, first measure the illumination at the centre of the screen under the conditions described in Appendix A, and then measure the illumination in the shadow of the baffle under the conditions described in B-2. The ratio of these two illumination values will be, in the case of matt screen, approximately the ratio required.

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